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Perceptions of eating practices and physical activity among Malaysian adolescents in secondary schools: A qualitative study with multi-stakeholders

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H.A.M., A.P., T.T.S. S.M., M.D., Z.T., L.J and R.J contributed to the conception and design of the study. H.A.M. and L.J. led the project and secured the necessary funds. SM., H.A.M., T.T.S., M.D., M.Y.J., M.N.A were responsible for data collection, transcription, coding and analysis. S.M., H.A.M., A.P., T.T.S. contributed to drafting the manuscript and provided critical input. All authors have read, revised and approved the final draft of the manuscript. ***Ethics of human subject participation:*** This study was conducted according to the guidelines laid down in the Declaration of Helsinki and all procedures involving research study participants were approved by the University of Malaya Medical Centre Research Ethics Committee (MREC ID NO: 2017106-5656). All participants (and/or the adolescents' parent or legal guardian) were asked to provide written informed consent before data collection commenced.

Abstract

Objective: To conduct formative research using qualitative methods among stakeholders of secondary schools to explore their perceptions, barriers, and facilitators related to healthy eating and physical activity among Malaysian adolescents.

Design: A qualitative study involving eight focus groups and 12 in-depth interviews. Focus groups and interviews were recorded and transcribed verbatim. An inductive thematic analysis approach was used to analyse the data.

Setting: Four secondary schools in Perak and Selangor states (two urban and two rural schools) in Malaysia.

Participants: Focus groups were conducted with 76 adolescents aged 13–14 years and in-depth interviews were conducted with four headmasters, four physical activity education (PE) teachers and four food canteen operators.

Results: Stakeholders thought that adolescents' misperceptions, limited availability of healthy options, unhealthy food preferences and affordability were important challenges preventing healthy eating at school. Low-quality PE classes, limited adolescent participation and teachers' commitment during lessons were perceived as barriers to adolescents being active at school. Affordability was the main challenge for adolescents from rural schools. Stakeholders perceived that a future school-based intervention should improve the availability and subsidies for healthy foods, provide health education/training for both adolescents and PE teachers, enhance active adolescent participation in PE and develop social support mechanisms to facilitate engagement with physical activity.

Conclusions: These findings provide important insights into developing school-based lifestyle interventions to improve healthy eating and strengthening physical activity of Malaysian adolescents.

Keywords: Diet; Physical activity; School-based; Adolescents; Malaysia

The prevalence of overweight and obesity among Malaysian adolescents has increased dramatically between 1986 and 2016 from 4% to 23% and 30% in girls and boys respectively ⁽¹⁾. The rise in the incidence of excess weight is a function of many factors consisting of raised access to foods high in fats, added sugars and calories^(2,3), increased eating outside the home⁽⁴⁾, larger portion sizes⁽⁵⁾, and a sedentary lifestyle^(6,7). Studies in Malaysia have suggested that adolescents tend to binge on energy-dense snacks and drinks ⁽⁸⁾ and follow a low-fibre, high-fat diet ⁽⁹⁾. In addition, a recent study in Malaysia has shown those schoolchildren who ate breakfast had a lower total LDL Cholesterol and Body Mass Index (BMI) compared to those who ate breakfast irregularly ⁽¹⁰⁾.

Fewer than 2% of Malaysian adolescents (mean age 12.9 years) achieve the recommended levels of moderate-to-vigorous physical activity (MVPA)⁽¹¹⁾, and they spend on average 4.7 hours per day on media-based recreation activities, such as television viewing and electronic games⁽¹²⁾. Data from the Malaysian School-Based Nutrition Survey 2012 and Nutrition Survey of Malaysian Children (SEANUTS Malaysia) showed that more than 50% of children and adolescents were considered as having low levels of physical activity (PA) ^(13, 14) and high levels of sedentary behaviour ⁽¹⁴⁾. Physical activity in Malaysian adolescents is, therefore, important ⁽¹⁵⁾.

The World Health Organisation (WHO) regarded schools as a critical setting for enhancing public health nutrition and reducing the risk of unhealthy weight gain in childhood ⁽¹⁶⁾. To date, school-based interventions outside of Malaysia have been found to improve physical activity. However, the impacts have been small, short-term and have mostly varied between interventions ^(17, 18, 19). Promising policies related to the school food environment have included the provision of fresh fruits and vegetables ⁽²⁰⁾, as well as restricting the sales of sugar-sweetened beverages in the school setting ⁽²¹⁾. However, the effects of these programmes and their long-term sustainability are uncertain. Furthermore, despite school nutrition policies and guidelines, international research suggests that most schools fail to implement them ^(22, 23).

The school food environment might be a useful means of improving dietary habits and promoting more active lifestyles in Malaysian adolescents, as, for example, two main meals (breakfast and lunch) are consumed by adolescents in this setting ⁽²⁴⁾. Generally, schoolchildren in Malaysia purchase food from the canteen and *koperasi* (school convenience shop). The *koperasi* sells school stationery, snacks and beverages, some of which are energy-dense. The staple foods sold at the canteen are fried rice and noodles, fried chicken and nuggets, energy-dense traditional cake and sugar-sweetened beverages (SSBs). A study in Malaysia highlighted that the limited variety of food and vegetables served in school canteens may lead to deficient intakes of vitamins and mineral among adolescents ⁽²⁵⁾. Besides, access to junk food sold near schools may encourage unhealthy food practices ⁽²⁶⁾, such as snacking between meals and skipping main meals ⁽²⁷⁾.

35 In Malaysia, there is a healthy food options guide for food and drink sales in school canteens
 36 and the school complex, which lists the approved or banned foods and beverages for the school
 37 canteen⁽²⁸⁾. This guideline is mandatory, but many school food canteens fail to adhere to it⁽²⁹⁾.

38 Two Malaysian ministries are responsible for regulating school food quality (the Ministries
 39 of Education (MoE) and Health (MoH)). They use three broad mechanisms, including 1) setting food
 40 quality standards for school canteens, 2) providing food preparation training programmes for canteen
 41 operators, and 3) monitoring canteen food quality. The deputy headmaster of a school should monitor
 42 quality standards, and a nutritionist from the MOH performs spot checks randomly throughout the
 43 year. However, canteen operators are rarely penalised for serving non-nutritious food; rather, the
 44 action is taken only in clear cases of food poisoning⁽²⁸⁾.

45 Internationally, governments have implemented school-based nutrition policies to restrict the
 46 sale of unhealthy foods^(30, 31). Nevertheless, it also has challenges like conflicts with time for other
 47 school activities, different interests of the stakeholders (food canteen operators) (e.g., financial profit
 48 vs. healthiness), or that the materials would not be applied as proposed⁽³²⁾. Incorporating the
 49 contribution of stakeholders throughout the development phase in combination with evidence-based
 50 knowledge, frameworks and behaviour change approaches could improve interventions to address
 51 the identified challenges⁽³³⁾.

52 In Malaysia, the ME subsidised food (breakfast) programmes are limited to students with low-
 53 socioeconomic backgrounds at primary schools. However, extending this subsidy to secondary
 54 schools may provide more opportunities to eat more healthily, particularly for adolescents from low
 55 socio-economic backgrounds⁽³⁴⁾.

56 Physical education (PE) in Malaysia is a compulsory subject taught in all primary and
 57 secondary schools. PE has the same status as other subjects in the school curriculum and is recognised
 58 as on par with other core subjects, although it is not a formally assessed subject. Tests for all physical
 59 fitness components are carried out on every student, and the results will be recorded. PE teachers in
 60 Malaysian schools comprise both PE majors and non-majors⁽³⁵⁾. PE is allocated two 40-minute
 61 periods for a week in secondary schools⁽³⁵⁾. A survey among Malaysian adolescents showed that
 62 some students complained about the quality of PE classes. They also stated that physical education
 63 (PE) lessons were often replaced with other lessons; the majority of PE teachers are not qualified and
 64 PE class has been sidelined by a majority of the schools⁽³⁵⁾.

65 A framework for the development and evaluation of complex interventions was established
 66 by the UK Medical Research Council (MRC)⁽³⁶⁾. A key stage in the development of such
 67 interventions is conducting formative research to identify the needs of the target population.

68 The term “stakeholders” refers to certain groups and individuals who have a legitimate
 69 interest, or a “stake”, in the continuing effectiveness and success of an institution⁽³⁷⁾. In the school

context, important stakeholders are parents, teachers, principals, and canteen managers^(38, 39). Stakeholders can express their experience, expected barriers or facilitators regarding the implementation of school canteen guidelines and improving the quality of physical activity at school⁽⁴⁰⁾. Meanwhile, numerous studies internationally have used multiple stakeholders to explore school food environments and physical activity among adolescents⁽⁴¹⁻⁴⁵⁾. However, to the best of our knowledge, no studies in Malaysia have explored concepts of healthy eating alongside physical activity, or discuss the barriers and facilitators for behaviour change in adolescents based on the multi-stakeholders' perceptions.

The present study was a needs assessment as a part of the MyHeART BEaT project^(34, 46) to guide the development of the content and structure of future intervention. Current research focuses on the application of qualitative methods to inform the development of a school-based intervention to promote healthier eating and physical activity among adolescents in Malaysia. We involved a variety of stakeholders in secondary schools (adolescents, principals, PE teachers and food canteen operators) to explore: a) stakeholders' perceptions of the provision of healthy food and physical activity in the school setting, and b) stakeholders' preferences and suggestions for school-based interventions to promote healthier eating and physical activity in Malaysia. Our findings may be relevant to other low- and middle-income settings.

Methods

Overview of the study setting

Malaysia's multilingual public school system provides free education for all Malaysians in addition to the availability of private schools and home-schooling. Education is not free in international and private schools. Secondary education lasts for five years, referred to as Form one (secondary one; grade 7; 12–13 years old) to five (16–17 years old; Secondary 5; grade 11). There are 5.5 million adolescents aged 10–19 years, which equates to approximately 19% of the total population; school enrolment in secondary education (% net) in Malaysia was reported at 72.2% in 2018⁽⁴⁷⁾.

Study design and participants

Semi-structured focus groups were conducted in February 2018 with Form 2 students aged 13-14 years, attending four secondary schools in Perak and Selangor states (two urban and two rural schools) in Malaysia. Convenience sampling was used to recruit adolescents. Teachers were asked to invite all Form 2 students to participate by distributing a participant information sheet and consent form to the parents of the students. During the same period, in-depth interviews, guided by structured question guides, were also conducted with multiple stakeholders (one PE teacher, one school principal

and one canteen operator) at each of the four schools. All participants (and/or the adolescents' parent or legal guardians) asked to provide written informed consent before data collection commenced.

The questions were semi-structured focus groups and interview topic guides (different guide and questions) adapted from those used in previous studies but modified and developed to suit the context of the study^(48,49). Guides were pilot-tested among students and stakeholders for face validity to confirm the feasibility for data collection. The questions explored stakeholders' perceptions of healthy eating and physical activity in the school setting; barriers for physical activity and consuming healthy foods in the school canteen; and expectations of an acceptable school-based intervention.

Data collection

Focus group discussions

A total of eight focus groups (lasting on average 40 minutes, range 35-45 minutes) were conducted by two facilitators (SM and HAM), who were experienced and trained to conduct qualitative research (one researcher moderated the focus groups, and the other took detailed notes). Eight to ten adolescents participated in each focus group, which were conducted separately for girls and boys. Homogenous focus groups can create an atmosphere where students feel comfortable and free to speak, without having to defend their opinions. For example, females might not be able to express themselves freely in the presence of male participants. As all schools were Malay-based, focus groups were not arranged according to ethnicity (Malay, Chinese, and Indian).

In-depth interviews

Twelve face-to-face in-depth interviews were conducted in four secondary schools with the headmasters, teachers and canteen operators by a trained enumerator. Open-ended questions were asked. Interviews lasted approximately 30 minutes (range 25-35 minutes).

The focus groups and interviews were conducted in Malay, digitally recorded, transcribed verbatim and anonymised. For both focus groups and interviews, the arrangement and wording of the questions were revised, if necessary, to explore emerging themes. Towards the end of the focus groups and interviews, the facilitator summarised the notes taken to participants to confirm their accuracy.

Data analysis

Data analysis was carried out in Malay, and translation of the data into English was limited to selected quotes. Analysing data in the original language prevents potential misinterpretations of participants' statements⁽⁵⁰⁻⁵⁴⁾. Two independent data analysts (FAB and SRR) listened to the recordings to check precision with the transcriptions. Transcripts were also compared with the facilitator's detailed notes

to ascertain their credibility. The analysis of transcripts was conducted by two trained researchers (FAB and SRR) and subsequently verified by HAM/MD/TTS/MYJ. Selected themes and quotes were translated into English by FAB and SRR, who are native Malay speakers, and back-translated to Malay by an independent bilingual researcher (HAM). Data collection and analysis were in parallel, so that data collection was completed when saturation was reached (i.e. data had a range of perceptions and variation of replies of participants, and no new themes arose from the analysis). Data organisation and coding were facilitated by NVivo software version 10 (QRS International Pty Ltd, UK).

Data were analysed thematically⁽⁵⁵⁾, following an inductive approach by using a framework method, which included five stages⁽⁵⁶⁾. First, familiarisation with the data was conceded by reading transcripts repeatedly. Second, two trained researchers (FAB and SRR, who are both Malay, English speakers) separately open-coded three randomly selected transcripts to start categorising data, so they could be compared with the rest of the data set. Third, coding inconsistencies (e.g. dissimilarities in terms used by the coders and whether codes were suitable to respond to the research questions) were discussed until a set of codes that made an initial framework was agreed. Based on this, the remaining transcripts were independently coded to establish any new themes and codes. Then, the coders discussed again to refine the initial framework, detect new codes and themes.

Inter-coder reliability was 95%, as calculated by dividing the number of agreements by the sum of agreement and disagreements. Fourth, indexing (systematically applying the framework to all transcripts) was applied by one researcher using the qualitative data analysis software NVivo version 10 (QRS International Pty Ltd, UK), which simplified the comparison of similarities and differences within and between the focus groups/interviews, and the evaluation of patterns in the views of participants, according to each theme. Finally, charting data into the framework matrix was carried out by reordering the data in a chart. Themes were organised and reorganised into themes and sub-themes as described for thematic analysis⁽⁵⁵⁾. Themes and sub-themes are supported in this report by representative quotations from participants (indicated by gender, rural/urban and stakeholder). These were selected to best reflect the variety of answers.

Results

The focus groups and in-depth interviews were conducted with 76 adolescents (38 boys; 38 girls) and multiple stakeholders (n=12) from four schools, respectively. Stakeholders were principal (2 female; 2 male), physical education teacher (1 female; 3 male) and canteen operator (3 female; 1 male). Table 1 shows the characteristics of participants of focus groups and in-depth interviews in two urban and two rural schools. We identified several themes around the challenges faced by adolescents,

stakeholders, and suggestions that would need to be considered when designing future interventions to promote healthier eating and physical activity in secondary schools in Malaysia (Table 2). Examples of responses related to healthy eating and physical activity based on these themes are shown in Tables 3 and 4, respectively. In addition, the Malay version of responses is available in Supplementary material 1. The summary of the findings and their implications for the development of an intervention to promote healthier eating and physical activity among Malaysian adolescents are described in Table 5.

Challenges around healthy eating

Perceptions of healthy eating

Adolescents seemed to have common misconceptions of healthy eating, and most perceived fried food as being healthy. One adolescent perceived that fried rice served in the school canteen was healthy because it contains small amounts of vegetables. According to the interviews with the principals, students tended to associate healthy food with foods that are not tasty.

Some adolescents mentioned that their families' guidance helped them to change their understanding of healthy food; some stated that their mothers prepare and provide advice on food selection. Overall, adolescents thought that healthy foods were being served by the school canteen, with fried chicken, fried rice, and coconut milk rice being considered healthy foods.

Canteen operators perceived that healthy eating would not be feasible since healthy food is unpopular among adolescents and, therefore, selling healthy foods would not be a profitable practice. When asked about their comprehension of healthy food options, operators seemed to misunderstand what healthy options might be, with one giving an example that an ice-cream filled bun would be a healthy snack for adolescents.

Limited healthy food options at the school canteen

Adolescents generally agreed with each other that canteen vendors offer them limited options of food. Deep-fried and oily foods, like fried chicken and fried rice, were common options bought from the canteen. They also perceived that the school canteen provided insufficient amounts of healthy options, like fruits and vegetables, especially in rural schools.

Principals acknowledged the limited variety of foods in canteens and explained that food items are usually sold with profits and the cost of the raw materials in mind. One principal explained that the foods available could still form part of a balanced diet despite healthy options, such as fruit, is limited and other foods having a high in fat content.

Canteen operators explained that they are following the Healthy Canteen Guidelines provided by the Ministry of Health in Malaysia. They thought the limited healthy options offered in school

canteens were the result of a ‘supply and demand factor’ by the students, whereby adolescents prefer quick and simple food options and have a low interest towards healthy foods. Operators perceived that selling healthier foods would result in fewer purchases, which in turn would cause food waste and a financial loss to the canteen.

213

Preference and affordability to buy healthy food options at the school canteen

Principals perceived that adolescents preferred buying unhealthy options in the canteen, as they are more filling (calorie-dense such as junk foods) than healthier foods. Canteen operators also seemed to agree with this notion, in that adolescents preferred to buy filling foods (calorie-dense such as junk foods), even if they were unhealthy.

Adolescents also reported preferring to buy their meals in the canteen because the menu has filling foods, thus preventing hunger during the school period. Adolescents from the rural area also stated a lack of money to buy food, mainly when asked about obstacles to healthy eating.

Principals from rural schools mentioned that adolescents at their schools came from low socio-economic backgrounds and it was common that they come to school without, or with minimal, pocket money, thus limiting their ability to buy foods in the first place. Canteen operators corroborated this. Particular to this issue, we found that students within urban schools prefer unhealthy and filling foods (to fight hunger without caring about the nutritional value) and affordability was not the primary concern.

228

Opportunities around healthy eating

Availability of healthy food options at the school canteen

Principals expressed the view that only healthy foods should be made available at the school canteen and the sale of unhealthy foods should be prohibited to enhance healthy eating behaviours among adolescents.

Most adolescents thought that canteen operators increasing the availability of healthy food options would facilitate them choosing healthy foods. One adolescent even suggested that foods available should form parts of a balanced diet, such as fruits and vegetable dishes. However, canteen operators explained that healthy food options were limited because some equipment for healthy cooking (e.g. utensils for roasting or steaming) are not available and often expensive for them to acquire and use when preparing meals.

240

Subsidising healthy foods at the school canteen

Subsidising raw ingredients and providing food coupons were some of the approaches suggested by the stakeholders to promote healthier eating. Both principals and canteen operators agreed that

healthy eating could be made possible if food subsidies were provided to the schools. Adolescents also reported that providing subsidies to reduce the burden of cost to canteen operators would allow healthy foods to be sold at lower prices. They emphasised the need for canteens to have healthy food options at lower prices, which would increase the likelihood of them opting for healthy foods.

Healthy eating education and training

All principals suggested that health education programmes should run throughout the year to change attitudes towards healthy food among adolescents. Some suggestions involved campaigns and festivals providing free healthy foods in order to encourage students to try them.

Adolescents, however, gave mixed responses when asked about the potential for health education to promote healthier eating in schools. Some adolescents were against this suggestion, explaining that educational materials, such as brochures, would not help to enhance literacy around healthy eating. However, some adolescents thought that health education might be useful, as it might help students learn to distinguish healthy from unhealthy food options.

Canteen operators seemed to like the idea of offering them the opportunity to enrol in healthy cooking classes. They would also favour receiving guidance, for example, alternatives to unhealthy foods and healthy recipes, as well as making healthy cooking tools available to aid them in preparing healthy food for students.

Challenges around physical activity

Quality of PE classes

Adolescents often thought that the PE classes offered at school were short and boring, offering a limited variety of activities. Insufficient sports equipment and teaching materials were commonly perceived among PE teachers as challenges around physical activity in schools. The quality of PE classes was an issue mentioned by adolescents; they perceived that the low teacher-student ratio hampered the efficiency of the sessions. This was particularly the case for rural schools, which have limited equipment reducing opportunities for students to participate in more activities.

Students' participation in PE classes

In both rural and urban schools, principals, PE teachers, as well as adolescents, thought that PE classes had low participation from students. Some adolescents, in particular, reported that despite attending the classes, they preferred not to participate in the activities. PE teachers perceived that participation in classes depended on adolescents' interests and personal preferences, whereas principals thought that low participation might be because PE classes were not assessed formally.

279 *Teachers' commitment to PE classes*

280 Adolescents reported that one of the challenges they faced during PE classes was that teachers were
 281 not fully committed to the class. They mentioned that teachers were not active and often instructed
 282 students to do their activity. This was highlighted in both urban and rural schools.

283 Principals explained that PE teachers' low commitment towards their classes was mainly due
 284 to limited skills, as many did not have a PE background and were employed as temporary staff. One
 285 of the teachers explained that they were often unable to follow the activity procedures to avoid injury
 286 to students, especially with regards to technical activities.

287
 288 ***Opportunities around physical activity***

289 *PE training for temporary teachers*

290 Principals and PE teachers felt that more training should be provided to the teachers to conduct PE
 291 classes appropriately. As the number of PE teachers is limited, both of these stakeholders largely
 292 agreed that training would aid teachers' skills and methods for delivering the classes.

293
 294 *Encouraging students' involvement in physical activity*

295 In order to encourage student participation in physical activity, most adolescents suggested that
 296 schools should consider increasing both the frequency and duration of PE classes so that they have
 297 many opportunities to be more physically active. Students also felt that peer encouragement would
 298 help them to get involved and become more physically active. One of the principals also suggested
 299 that friends acting as a role model for specific activities would increase adolescents' involvement in
 300 classes. For example, an adolescent who plays football could help teach their friends the proper
 301 techniques to play the sport.

302 In addition, PE teachers suggested the implementation of a reward system for adolescents,
 303 especially those who are highly likely to not participate in PE classes. The reward system may
 304 function by engaging students to join the planned class, before giving them their reward of doing their
 305 preferred activity. Furthermore, both principals and PE teachers suggested that sports competitions
 306 could be an outlet to help increase adolescents' interest to get involved in physical activities.

307
 308 *Parental support for adolescents' physical activities*

309 Students from both rural and urban schools mentioned that they tend to be more physically active
 310 when they receive support from their parents. Examples of parental support provided by the students
 311 to facilitate this included parents dropping them off at sports facilities and joining them when
 312 engaging in physical activity.

Principals also addressed the importance of active parental support to promote adolescents' physical activity and mentioned that schools had implemented a system, called SSDM (*Sistem Sahsiah Diri Murid*) or Students' Self-Affair System, whereby a warning letter is issued to students who missed a PE class. After three absences, the school counsellor contacts the parents to discuss appropriate actions.

Discussion

In our qualitative study, Malaysian adolescents, school principals, PE teachers and canteen operators highlighted several challenges with regards to healthy eating and physical activity in secondary schools. Participants provided important insights on how the school environment could facilitate healthier eating and physical activity, including subsidising and increasing the availability of healthy foods; providing nutrition and physical activity training for adolescents and stakeholders; and encouraging adolescents to participate in physical activity via peer and parental support. These insights are essential to inform interventions to promote healthy eating and physical activity in secondary schools in Malaysia.

The main barriers for healthy eating at school identified by adolescents in the current sample included the lack of healthy food options, the availability of unhealthy foods and issues around preferences and affordability. In addition, there seemed to be several misconceptions regarding what constitutes healthy eating, which might have contributed to adolescents' consumption of more unhealthy foods. Our finding is in contrast to a study of Irish adolescents, who had a good understanding of what healthy eating involves⁽⁵⁷⁾. Both adolescents in the current and earlier qualitative studies^(57, 58) perceived that food preferences and foods sensory qualities (i.e. texture, appearance and smell) play a more central role in their food choices. This is corroborated by a study of 40 adolescents in Swiss schools, who perceived that enhancing the attractiveness of healthy choices would be the most effective approach to improving eating habits⁽⁵⁹⁾.

Families, especially mothers, were described as influencing the food habits and perceptions of healthy food of Malaysian adolescents. This was also highlighted in studies among adolescents^(60, 61). Since mothers were typically regarded as being responsible for preparing family meals^(62, 63), good maternal knowledge of nutrition could improve the quality of food intake and eating behaviour of adolescents at home⁽⁶⁴⁾.

Other barriers to healthy eating in secondary schools that have been reported in earlier research included poor school meal provision, ease of access, and the relatively low cost of fast food⁽⁶⁵⁾. In contrast, healthy eating has been suggested to be facilitated by parental support, broader accessibility of healthy foods, desire to look after one's appearance and will-power⁽⁶⁵⁾. Some of these

findings agree with the current study's results, where adolescents suggested that increasing the availability and reducing the cost of healthy foods would help them make healthier choices in the school canteen.

School food environments are different between rural and urban areas⁽⁶⁶⁾. Identified challenges in rural schools include limited administrative capacity, difficulty hiring and retaining qualified staffs, physical infrastructure limitations, as well as limited food supply and purchasing options⁽⁶⁶⁻⁶⁷⁾. Food habits among rural adolescents are characterised by traditional food, and a lower frequency of milk products, meat/fish/eggs, vegetables and cereals. In contrast, adolescents in urban areas eat more junk food, have a higher amount of pocket money, and are engaged in less manual activities and walking than adolescents in rural areas⁽⁶⁸⁾.

Interestingly, perceptions of stakeholders in the current study did not often differ in urban or rural areas. One exception was that cost or affordability of foods offered in the school canteen, which might be a more important factor preventing healthier choices for adolescents based in rural, compared to urban, areas. Lack of money to purchase healthy food was also a barrier to healthy eating for adolescents in earlier qualitative studies⁽⁶⁹⁻⁷¹⁾. Our findings suggest that inequalities in the foods consumed at urban and rural schools could potentially be overcome by using subsidies for healthy foods. In addition, some studies have shown that it is possible to improve food availability and increase sales of healthy items in secondary school canteens^(72, 73).

All stakeholders involved in the current study perceived that the main barriers for adolescents being physically active at school were the low-quality of PE classes; adolescents' low level of participation in classes; and PE teachers' limited skills and commitment. Lack of time to engage in physical activity during the PE class was another perceived challenge by adolescents, which is a barrier commonly observed elsewhere⁽⁷⁴⁻⁷⁶⁾. However, in these earlier reports, adolescents linked the lack of time to engage in physical activity due to school demands (e.g., overloaded curriculum, assignments, private lessons, and prioritising academic success).

In addition, obstacles related to infrastructure and available equipment were considered as barriers to promoting high-quality physical activity in schools by all stakeholders, which has been reported by earlier studies as well^(77,78). However, a Malaysian adolescent cohort study (MyHeARTs) highlighted that activities associated with higher fitness in adolescents typically took place outside of school, in the evening or at weekends⁽⁷⁹⁾, which suggests that PE may be less important than out-of-school physical activities for adolescent health.

All stakeholders highlighted that some adolescents do not engage during PE classes, potentially due to personal interests or preferences. Enjoyment of participation in PE classes is an important facilitator of adolescent physical activity⁽⁷⁸⁾ and offering a wider variety of activities during classes might help contribute to more active participation at school. In addition, to actively

engage adolescents in PE classes, PE teachers must be trained appropriately through Initial Teacher Training (ITT). When providing PE, a teacher should carefully consider how they will adapt demonstrations and explanations of the skills being taught to meet the needs of the students in their class and the intended content⁽⁸⁰⁾. Monitoring systems need to be proven effective to ensure that PE programmes in Malaysian schools are implemented properly. PE classes are not implemented uniformly across schools and largely depend on the discretion of the school head and management. This falls short of achieving the level that is required to realise the targeted health and well-being benefits. Moreover, an effective PE system requires the collaboration of its multiple stakeholders.

Finally, all stakeholders in the current study perceived social support and encouragement as important when promoting physical activity. Social support, particularly from friends, family and teachers, has been consistently linked to higher levels of adolescent physical activity in earlier research^(81,82).

A few school-based nutritional interventions have been implemented in Malaysia⁽⁸³⁻⁸⁶⁾. However, most interventions to date are focused on either the prevention of obesity or disordered eating, rather than general improvements to nutrition and physical activity in all students. To our knowledge, Malaysia does not have a comprehensive intervention programme that promotes the components of healthy eating and an active lifestyle among adolescents.

Two previous canteen-based food nutrition intervention studies in Malaysia successfully improved healthy food knowledge among food handlers⁽²⁵⁾ and students' perception of healthy food choices⁽⁸⁷⁾. However, there was no evidence of improvement in the primary schoolchildren's preferences for fruits⁽⁸⁷⁾. The intervention between food handlers found that almost one-third of fast food and food not recommended for sale were available in the canteens because school canteens prioritised making profits⁽²⁵⁾. Meanwhile, there is still some gaps in data and demand for appropriate nutrition intervention among adolescents.

To our knowledge, this is the first study to utilise the MRC framework for the development of complex interventions for schoolchildren in Malaysia⁽³⁸⁾. We explored secondary school stakeholders' perceptions to inform the design of a future intervention to improve dietary and physical activity behaviours in Malaysian adolescents. Use of the MRC framework is a strength of this study, as conducting this type of formative research before intervention development is likely to result in more feasible and acceptable interventions. A wide range of stakeholders was involved (adolescents, principals, teachers and canteen operators), who were recruited from both urban and rural areas of Malaysia, thus enabling a wide range of insights into the topics explored. Nevertheless, the generalisability of the findings to different geographical regions of Malaysia cannot be assumed and, despite thematic data saturation being reached, the sample size was relatively small. Malaysia comprises three main ethnic groups (Malay, Chinese and Indian) but we only included schools that

were Malay-based and focus groups were not arranged according to ethnicity (Malay, Chinese, and Indian). Students of other ethnicities could have different perceptions due to potential cultural differences. All ethnicities should participate in future studies to develop inclusive interventions. The results cannot be generalised to adolescents studying in a non-formal education programme. Furthermore, the students may have given socially desirable answers throughout the focus group discussions, mainly when they could not express their problems or if they overstated their positive perceptions.

Conclusions

The current study suggests that several challenges and opportunities to following a healthy diet and engaging in high-quality physical activity in Malaysian secondary schools should be addressed in a future intervention to promote these behaviours among Malaysian adolescents. Stakeholders thought that adolescents' misperceptions, limited availability of healthy options, unhealthy food preferences and affordability were important challenges preventing healthy eating at school. Low-quality PE classes, limited adolescent participation and teachers' commitment during lessons perceived as barriers to adolescents being active at school. They perceived that a future school-based intervention should ideally improve the availability and subsidies for healthy foods, provide engaging in health education/training for both adolescents and PE teachers, enhance active adolescent participation in PE classes, provide adequate sports equipment and variety of physical activities, develop role modelling, and social support mechanisms to facilitate engagement with physical activity. Rather than providing adolescents with only relevant knowledge related to a healthy lifestyle, they require training to deal with the obstacles. Such educational platforms should also deliver knowledge and guidance related to physical activity and healthy eating for their parents. Results from our study can form the basis for the development of a school-based intervention to promote healthier eating and encourage physical activity to Malaysian adolescents.

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Table 1 Participation of focus groups and in-depth interviews in two urban and two rural schools

School	Focus groups	In-depth interviews
Urban School 1	(1) 10 boys	(1) Principal (Female)
	(1) 10 girls	(1) Physical education teacher (Male)
		(1) Canteen Operator (Female)
Urban School 2	(1) 8 boys	(1) Principal (Female)
	(1) 8 girls	(1) Physical education teacher (Male)
		(1) Canteen Operator (Female)
Rural school 1	(1) 10 boys	(1) Principal (Male)
	(1) 10 girls	(1) Physical education teacher (Female)
		(1) Canteen Operator (Female)
Rural school 2	(1) 10 boys	(1) Principal (Male)
	(1) 10 girls	(1) Physical education teacher (Male)
		(1) Canteen Operator (Male)
Total	8 focus groups	12 in-depth interviews
	38 boys (50%);	Principal (female 50%; male 50%)
	38 girls (50%)	Physical education teacher (female 25%; male 75%)
		Canteen operator (female 75%; male 25%)

Table 2 Challenges and opportunities for healthy eating and physical activity

Variables	Healthy eating	Physical activity
Challenges	<ul style="list-style-type: none"> • Perceptions of healthy eating • Limited healthy food options at the school canteen • Preference and affordability to buy healthy food options at the school canteen 	<ul style="list-style-type: none"> • Quality of PE classes • Students' participation in PE classes • Teachers' commitment to PE classes
Opportunities	<ul style="list-style-type: none"> • Availability of healthy food options at the school canteen • Subsidising healthy foods at the school canteen • Healthy eating education and training 	<ul style="list-style-type: none"> • PE training for temporary teachers • Encouraging students' involvement in physical activity • Parental support for adolescents' physical activities

Table 3 Challenges and opportunities around healthy eating arising in the eight focus groups discussions among adolescents (n=76) aged 13–14 years and 12 in-depth interviews (headmasters, PE teachers and food canteen operators) from four secondary schools in Perak and Selangor states of Malaysia

Theme/sub-theme	Example of responses
Challenges around healthy eating	
Perceptions of healthy eating	<p>‘Maybe fried rice because it contains vegetables.’ (Girl, Rural school 2)</p> <p>‘They (the adolescents) associated healthy food as not being tasty’. (Principal, Urban school 2, Female)</p> <p>‘My mother prepares and advises me to eat more vegetables. I eat whatever she cooks.’ (Girl, Urban school 1)</p> <p>‘To add some afternoon snacks, we are planning to sell ice-cream filled bun.’ (Canteen operator, Urban school 1, Female)</p>
Limited healthy food options at the school canteen	<p>‘If we were to discuss whether the food is somewhat nutritious...balanced food is there...but maybe with extra fat (content)...or limited food like fruits.’ (Principal, Urban school 2, Female)</p> <p>‘We sell what the students like...when the students don’t like it...then the food is not selling (well).’ (Canteen operator, Urban school 1, Female)</p>
Preference and affordability to buy healthy food options at the school canteen	<p>‘The near adolescents’ students are inclined to take filling food...so, they prefer to take rice, fried vermicelli, and so forth.’ (Principal, Urban school 2, Female)</p> <p>‘(We) sell foods that are filling to the students.’ (Canteen operator, Urban school 2, Female)</p> <p>‘I do eat (at the canteen). If I do, it is because I was hungry.’ (Boy, Urban school 1)</p> <p>‘I don’t have enough money to be able to eat well due to the low income of my father’. (Boy, Rural school 1)</p> <p>‘Parental income (of the students) is very low...so, some students do not bring pocket money.’ (Principal, Rural school 1, Male)</p>
Opportunities around healthy eating	
Availability of healthy food options at the school canteen	<p>‘Let’s say if we want to make changes...say to make a policy...the canteen is only allowed to sell healthy foods...foods that are oily will not be allowed.’ (Principal, Urban school 2, Female)</p> <p>‘Prepare healthier foods than unhealthy ones. We should consume fruits, vegetables, and healthy foods.’ (Boy, Urban school 1)</p>
Subsidising healthy foods at the school canteen	<p>‘So only healthy food choices... the healthy ones are the ones that we give subsidies to... at a (certain) price point...but sell them at a cheaper price...as an introductory move to the (healthy) foods.’ (Principal, Urban school 2, Female)</p> <p>‘I think in terms of (cost) of raw materials... because the price has spiked.’ (Canteen operator, Urban school 2, Female)</p> <p>‘Maybe reduce the (healthy) food price...like before this, some (students) could not afford to purchase them (healthy food).’ (Girl, Rural school 2)</p>
Healthy eating education and training	<p>‘Maybe the best approach is (having) a campaign... awareness campaign on healthy food and so forth... maybe if the University of Malaya can run a campaign together with us in school.’ (Principal, Urban school 1, Female)</p> <p>‘Sure if the Ministry is providing it (healthy cooking class) for us...we can follow the steps... just like the hospital canteen where the Ministry provides... so, if the Ministry provide it to us, it will not be an issue for us to follow.’ (Canteen operator, Rural school 1, Female)</p>

Table 4 Challenges and opportunities around physical activity in the eight focus groups discussions among adolescents (n=76) aged 13–14 years and 12 in-depth interviews (headmasters, PE teachers and food canteen operators) from four secondary schools in Perak and Selangor states of Malaysia

Theme/sub-theme	Example of responses
Challenges around PA	
Quality of PE classes	<p>‘In my opinion, the physical education class is boring because we often play the same sport.’ (Boy, Rural school 2)</p> <p>‘For the half an hour session, physical education is very short. If the students are delayed, the time will be even shorter (for activities).’ (Boy, Urban school 1)</p> <p>‘So, sometimes the equipment is minimal...with many students (using it) ...students have to wait a long time for their turn to use the equipment...have to take turns...even after the teacher has split them into smaller groups...but the waiting time is still quite long, in my opinion.’ (Physical education teacher, Urban School 1, Male)</p>
Students’ participation in PE classes	<p>‘If we were to talk about hindrance from students themselves, there are some (the students) who are not keen to do the physical activities...they will come to the field but not participate.’ (Principal, Urban school 2, Female)</p> <p>‘Sometimes it’s not okay; some students prefer to chat and did not join (the activities).’ (Girl, Rural school 1)</p> <p>‘When they come, they come unprepared to do physical activities due to lack of interest...no awareness.’ (Physical education teacher, Urban school 1, Male)</p> <p>‘Because physical education is not subject to examination.’ (Principal, Urban school 1, Female)</p>
Teachers’ commitment to PE classes	<p>‘The teacher is not active and often lets us decide to play (on the field) by ourselves.’ (Girl, Rural school 2)</p> <p>‘(Our) teacher often asked us to play by ourselves.’ (Girl, Urban school 1)</p> <p>‘It’s just that some of the activities were not performed...where most of our teachers are temporary hence there were several activities that we are not brave enough to conduct with the students...as they are quite dangerous when not following the correct procedure.’ (Physical education teacher, Rural school 2, Male)</p>
Opportunities around PA	
PE training for temporary teachers	<p>‘They needed help... firstly, in terms of skills (acquirement)...especially for the temporary female teacher.’ (Principal, Urban school 1, Female)</p> <p>‘To provide the opportunity for specific training (programmes) for these (temporary) teachers...so, we will be utilising this opportunity to instil the required skills for them to teach.’ (Physical education Teacher, Rural school 1, Female)</p>
Encouraging students’ involvement in physical activity	<p>‘Increase the activities...allocate us more time...that’s all.’ (Boy, Rural school 1)</p> <p>‘The student will become a model... he will show (correct techniques) to his friends.’ (Principal, Urban school 1, Female)</p> <p>‘One request ... for example, we have an hour... I would utilise 15 minutes to focus on track and field (activity)... meaning if you (the students) do it seriously... I (the teacher) will allow you (the student) to play football or... other activities... it seems like they (the students) are responding (positively) to this (approach).’ (Physical education teacher, Urban school 2, Male)</p>
Parental support for adolescents’ physical activities	<p>‘In terms of family, they told me to be active. Play sports like running to lose weight. Make the body fit. That’s all (Boy, Urban school 2)</p> <p>‘I like to do... what do they call it?... fitness with my mum and my dad.’ (Girl, Rural school 1)</p> <p>‘Starting from 2018... The State Education Department has ordered us to implement SSDM... A warning letter will be issued under the system and first and second and third warnings are issued, and at the same time (after third warning), we will request the school counsellor to pay the student a house visit to investigate.’ (Principal, Rural school 1, Male)</p>

Table 5 Implications of findings for the development of an intervention to promote healthier eating and physical activity among adolescents in secondary schools in Malaysia

Key components to be addressed	Desired outcome	Potential intervention content to achieve the outcome
Availability of healthy food options at school canteen	Increasing the availability of healthy food options at the school canteen.	School-based Healthy School Canteen programme can be a promising intervention to change the school food environment.
Subsidising healthy foods at the school canteen	Improving the subsidisation of healthy foods at schools.	School-based policies to improve the relative availability of healthy foods for sale at the school canteen.
Healthy eating education and training	Improving healthy eating education and training for healthy eating among adolescents and canteen operators.	Development of appropriate educational materials and training sessions for adolescents and canteen operators.
PE training for temporary teachers	Understanding the preferred method for training temporary teachers related to physical education classes.	The provision of an online and face-to-face training platform for temporary teachers related to PE classes and employment of trained staff.
Encouraging students' involvement in physical activity	Understanding the preferred method to encourage student's involvement in physical education classes.	Adopting a participant-led approach to change and providing adequate sports equipment and a wide variety of activities to account for adolescents' individual preferences.
Parental support for adolescents' physical activities	Understanding the preferred method to get the family support adolescents' physical activities.	Development of evidence-based interventions to get the family support for adolescents' physical activities.